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SPOOR AND FISHER

REPUBLIC OF SOUTH AFRICA REVENUE F RM P.1
17.6.94 R 200.00
INKOMSTE REPUBLIEK VAN SUID AFRIKA
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REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

APPLICATION FOR A PATENT

AND ACKNOWLEDGEMENT OF RECEIPT
(Section 30 (1) - Regulation 22)

The granting of a patent is hereby requested by the undermentioned applicant on the basis of the present application in duplicate

OFFICIAL APPLICATION No.			S & F REFERENCE
21	01	94 4327	JP/A791

FULL NAME(S) OF APPLICANT(S)

71	ADVANCED TRANSPORTATION INFORMATION SYSTEMS (PROPRIETARY) LIMITED

ADDRESS(ES) OF APPLICANT(S)

	THE WORKS BUILDING, SUITE 601, 258 BROOKLYN ROAD, MENLO PARK, PRETORIA, REPUBLIC OF SOUTH AFRICA

TITLE OF INVENTION

54	MONITORING THE DISPENSING OF A FLUENT MATERIAL

THE APPLICANT CLAIMS PRIORITY AS SET OUT ON THE ACCOMPANYING FORM P.2. THE EARLIEST PRIORITY CLAIMED IS:

COUNTRY:	NUMBER:	DATE:
ZA	93/1477	17.03.93

THIS APPLICATION IS FOR A PATENT OF ADDITION TO PATENT APPLICATION NO.

21	01	

THIS APPLICATION IS A FRESH APPLICATION IN TERMS OF SECTION 37 AND IS BASED ON APPLICATION NO.

21	01	

THIS APPLICATION IS ACCOMPANIED BY:

- [x] 1. Two copies of a complete specification of 20 pages.
- [x] 2. Drawings of 4 sheets.
- [x] 3. Publication particulars and abstract (Form P.8 in duplicate).
- [x] 4. A copy of Figure 1 of the drawings (if any) for the abstract.
- [ ] 5. An assignment of invention.
- [ ] 6. Certified priority document(s) .
- [ ] 7. Translation of the priority document(s).
- [ ] 8. An assignment of priority rights.
- [x] 9. A copy of the Form P.2. and the specification of S.A. Patent Application No. 93/1477
- [ ] 10. A declaration and power of attorney on Form P.3.
- [ ] 11. Request for ante-dating on Form P.4.
- [ ] 12. Request for classification on Form P.9.
- [ ] 13.

74	ADDRESS FOR SERVICE: SPOOR AND FISHER, SANDTON

Dated : 17TH JUNE 1994

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RECEIVED 1994-06-17

REGISTRAR OF PATENTS

SPOOR AND FISHER

FORM P.7
(To be lodged in duplicate)

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

COMPLETE SPECIFICATION

(Section 30(1) - Regulation 28)

OFFICIAL APPLICATION NO.			LODGING DATE	
21	01	94327	22	17.06.94

INTERNATIONAL CLASSIFICATION	
51	B67D

FULL NAME(S) OF APPLICANT(S)

71	ADVANCED TRANSPORTATION INFORMATION SYSTEMS (PROPRIETARY) LIMITED

FULL NAME(S) OF INVENTOR(S)

72	CONRAD MORTIMER BROWNLEE-WALKER; MARTIN CHRISTO VAN BREDA

TITLE OF INVENTION

54	MONITORING THE DISPENSING OF A FLUENT MATERIAL

BACKGROUND TO THE INVENTION

THIS invention relates to an apparatus for and a method of monitoring the dispensing of a fluent material such as liquid fuel.

The fuelling of vehicles, and especially the fuelling of commercial vehicles is becoming increasingly subject to theft and fraud. Existing fleet cards are prone to abuse, and are often used by unauthorised personnel for the filling of unauthorised vehicles and receptacles such as jerry cans.

It is an object of the invention to ensure that fuel is only dispensed by authorised personnel to vehicles which they have been authorised to fill.

SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided an apparatus for monitoring the dispensing of a fluent material from a dispensing outlet to a receptacle inlet, the apparatus comprising sensing means for sensing when the dispensing outlet is in communication with receptacle inlet, and control means responsive to the sensing means and being arranged to enable the fluent material to be dispensed into the receptacle inlet only when the dispensing outlet is in communication therewith.

In a preferred form of the invention, the sensing means includes identification means arranged to generate an identification signal associated with the receptacle inlet, and receiving means associated with the dispensing outlet for receiving the identification signal.

Preferably, the identification means is arranged to transmit a first identification code identifying the receptacle in response to an activation signed from a transmitter associated with the dispensing outlet, and the control means includes entry means for entering a second code, and comparator means for comparing the first and second codes, the control means being arranged to enable fluid to be dispensed only in the event of the first identification code matching the second identification code.

Conveniently, the identification means comprises an encoded tag and mounting means for mounting the tag adjacent the receptacle inlet.

The mounting means typically includes tag destruction means for rendering the tag inoperable on unauthorised removal of or tampering with the tag.

Advantageously, the receiving means comprises a transmitting and receiving antenna carried on the dispensing outlet, the antenna being arranged to receive the identification signal from the identification means only in the event of the dispensing outlet being in communication with the receptacle inlet.

Conductor means may be provided for conducting the identification signal from the transmitter to the control means, the conductor means including an inductive coil arrangement provided on opposite sides of a rotary coupling.

The tag may comprise a tuned sense coil, and a transmitter arranged to be modulated by the sense coil.

The dispensing outlet is conveniently movable between a stowage position on a fixture and a dispensing position, and remote powering means are provided on the fixture for remotely powering the receiving means. Conveniently, the remote powering means is arranged, via the control means, to inhibit the operation of the receiver means when the dispensing outlet is in the stowage position.

The apparatus may include synchronisation means arranged to assign characteristic time slots to a plurality of receiving means for allowing plurality of receiving means to operate simultaneously.

Conveniently, the second code is stored on a memory device, such as a magnetic or a smart card, and the entry means comprises a keyboard, a magnetic card reader or a smart card reader.

Advantageously, additional restrictive data is stored on the memory device, such as a maximum quota of fluent material, and a list of permitted dispensing outlets, with the control means being operable to prevent the dispensing of fluent material in response to receipt of the restrictive data.

The control means may be arranged to write data back into the memory device, the data including at least one of the following, namely the amount of fluent material dispensed in respect of a particular transaction, the cost of such material, the time and date, the identity of dispensing outlet, and an odometer reading.

The antenna is advantageously arranged to transmit the identification signal to the control means.

The invention extends to a method of monitoring the dispensing of a fluent material from a dispensing outlet to a receptacle inlet, comprising the steps of:

a) sensing when the dispensing outlet is in communication with the receptacle inlet;

b) allowing fluent material to be dispensed when the dispensing outlet is in

communication with the receptacle inlet, and

c) barring the dispensing of fluent material when the dispensing outlet is moved out of communication with the receptacle inlet.

Preferably, the method includes the steps of transmitting a first identification code associated with the receptacle inlet to a control station, entering a second identification code at the control station, comparing the first and the second identification codes and enabling the dispensing of fluent material only in the event of the first and second identification codes matching and the dispensing outlet being in communication with the receptacle inlet.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a schematic block diagram of an apparatus for monitoring the dispensing of fuel;

Figures 2A & 2B show respective cross-sectional side and end-on views of an identification tag assembly arranged to be mounted to a light vehicle;

Figure 3 shows the location of the identification tag assembly of Figures 2A and 2B adjacent a

fuel inlet of a light vehicle;

Figure 4 shows a second embodiment of an identification tag assembly mounted to the inlet of a fuel tank of a heavy vehicle;

Figures 5A & 5B show respective cross-sectional front and top plan views of the tag of Figure 4;

Figure 6 shows a front view of a third embodiment of an identification tag of the invention;

Figures 7A & 7B show cross-sections on the lines 7A-7A and 7B-7B of Figure 6;

Figure 8 shows a side view of a first embodiment of a hose antenna mounted adjacent the nozzle of a fuel hose;

Figure 8A shows a section on the line 8A-8A of Figure 8;

Figure 9 shows a side view of a second embodiment of a hose antenna;

Figure 9A shows a section on the line 9A-9A of Figure 9; and

Figure 10 shows a perspective exploded view of a rotary inductive coupling forming part of the apparatus of the invention;

Figure 11 shows a functional block diagram of a fourth embodiment of a tag of the invention;

Figure 12 shows a circuit block diagram of a reader module for reading the tag of Figure 11;

Figure 13 shows a block circuit diagram of a pump driver module for use in combination with the tag and reader module of Figures 11 and 12; and

Figure 14 shows a data transmission timing diagram of timing pulses for the driver module.

DESCRIPTION OF EMBODIMENTS

The fuel monitoring apparatus illustrated in Figure 1 includes a control unit 10 which is located within the housing of a fuel pump 12. A conventional fuel hose 14 leads from the fuel pump and terminates in a fuel nozzle 16. Mounted at the base of the nozzle 16 is an antenna 18, the operation of which will be described further on in the specification. The end of the nozzle 16 is shown being inserted into a fuel inlet pipe

20 which leads to the fuel tank 22 of a heavy duty truck 24.

A computer or CPU 26 controls the operation of the control unit 10. An RF reader module 28 is coupled to the computer 26, and is arranged to read RF signals received by the antenna 18. A keypad 30 and an alphanumeric display screen 32 are similarly linked to the computer 26. A printer 34 provides hard copies of the various transactions, and is used as a back-up to trace the history of past transactions should the electronics fail. A smart card reader 36 may be linked to the computer 26 via a multiplexer unit 38, which allows the control unit 10 to be expanded to cover multi-hose pumps incorporating additional smart card readers 40. Similarly, an RF antenna multiplexer unit 42 may be fitted between the RF reader module 28 and the hose 14 to provide for multi-hose pumps having additional hoses 44.

Turning now to Figures 2A and 2B, an identification tag assembly 47 includes an electronic identification tag 48 embedded within a tubular glass vial 50. Opposite ends of the vial 50 are in turn affixed to a plastic support cradle 52, and a length of steel wire 54 is fed through mounting apertures 56 formed in the vehicle body 58. The wire 54 encircles the support cradle 52 and the vial 50, and the ends of the wire 54 are twisted together so as to form a loop. Any attempt to remove the identification tag 48 will result in pressure from the steel wire 54 shattering the vial 50, thereby destroying the tag and rendering it inoperable. The entire assembly is housed beneath a cover 60 formed from an epoxy material or the like. It is clear from Figure 3 how the identification tag assembly 47 is mounted within a fuel cap recess 62 of a light vehicle adjacent the fuel inlet pipe 64.

Turning now to Figure 4, a typical fuel tank configuration for a larger vehicle is shown in which the fuel spigot, or inlet pipe 66 extends from a fuel tank 68. An annular tag assembly 70 is shown clamped around the spigot opening. As is clear from Figure 5A, the tag assembly 70 comprises an identification tag 72 embedded within a glass vial 74. The glass vial 74 is in turn glued in place within an aperture 75 which extends through opposite halves 76 and 78 of a split nylon ring 80. A nut 82 is screwed onto a bolt 84 so as to hold the opposite ends of the ring halves 76 and 78 together. A spring 86 is located in a chamber 88 defined between the halves 76 and 78. On loosening of the nut 82, the coiled spring 88 expands, thereby forcibly opening the halves 76 and 78 of the ring, and shattering the vial 74.

Turning now to Figures 6, 7A and 7B, an alternative tag assembly 90 is shown in which the glass vial 74 is fixed coaxially relative to the central axis of the fuel pipe 66. A nylon ring is formed from two halves 92 and 94 which are arranged to pivot about a pivot pin 96 which is located adjacent the vial 74. A retaining screw 98 holds the opposite halves 92 and 94 of the nylon ring together. It is clear from Figure 7B how loosening of the screw 98 will cause the opposite halves 92 and 94 to separate as a coil spring 100 expands, thereby shattering the vial 74 by a shearing action. This arrangement is preferable if the distance from the nozzle antenna 18 to the identification tag needs to be in excess of 10cm.

In Figure 8, an antenna 102 is shown mounted at the base of a fuel outlet nozzle 104. As is clear from Figure 8, the antenna 102 comprises

an annulus 106 carrying an array of evenly spaced ferrite-cored coils 108. A lead 109 extends from the antenna 102 past the fuel control handle 110 to an inductive coupling coil arrangement 112. The coupling coil arrangement 112 comprises a first ring-shaped ferrite-cored coil 114 mounted to the fixed end of the fuel nozzle, and a second ferrite-cored coil 116 mounted to the end of the fuel hose 14. The end of the fuel hose 14 is mounted to the fixed end of the nozzle by means of a rotary coupling 118. Inductive coupling between the coils 114 and 116 provides for the transfer of signals from the antenna 102 to the RF antenna multiplexer 46 via a signal line 117 embedded within the hose sheathing.

Turning now to Figures 9 and 9A, an alternative embodiment of an antenna coil 120 is shown. The antenna coil 120 is in the form of a ring antenna which is mounted to the outer periphery of a dished splash cover 122 at the base of the fuel outlet nozzle 104.

The rotary coupling arrangement is shown more clearly in Figure 10. Each coil 114 and 116 is in the shape of an apertured disc having a ferrite core 124 surrounded by circumferential coil winding 126 so as to provide an inductive coupling with minimal losses.

The filling hose of a commercial fuel pump is subject to considerable abuse and needs to be regularly replaced. Consequently, for this harsh environment, an alternative embodiment eliminates the electrical leads on the base and the rotary couplings on the nozzle and pump. This embodiment comprise three elements which differ from those described above, namely, the tag 48 mounted on the vehicle, the RF reader module 28 and the antenna multiplexer 42, and the hose cable, coupling and antenna assemblies 18 of Figures 8, 8a and 9.

Referring to Figure 11, the tag consists of a tuned sense coil 150, the output of which is detected and amplified by an amplifier 152. This output clocks through the 32 bit ID code stored in shift-register 154 the output of which in turn modulates a transmitter 156, the signal being radiated by an antenna 158. A typical operating frequency is in the UHF band, such as 405 MHz, the exact choice depending on the local regulatory authorities. A tiny battery powers the tag and since power is only consumed when the sense coil is active, lifetimes in excess of ten years can easily be achieved. With microminiature components, packing and mounting of the tag can be similar to that described above.

Referring now to Figure 12, a self-contained battery powered reader module 159 is mounted on the hose nozzle. This module has a power pickup coil 160 which receives energy from a pump driver module coil 200 of Figure 13 when the nozzle is resting on the side of the pump. The pump driver module charges a battery 162, provides synchronised reset pulses 163 as shown in Figure 14 and inhibits the output of the reader module. As soon as the nozzle is removed from the side of the pump, signals from a crystal oscillator 164 are divided down by a divider 166 and drive the shift register 168. Each pump in a given locale is set for a different output which causes it to transmit in a unique time slot as shown in Figure 14. When the output is active, the crystal oscillator drives the power amplifier 170 which energises the trigger coil 172. This causes the tag to transmit as described above.

Located at the resting position of each fuel hose is a pump driver module 173 which receives synchronised pulses 163 from a master oscillator 174 driving all the pump driver modules in the area. These

pulses inhibit the oscillator output 174 for a short time (a few milliseconds) as regular intervals, say once per second. These pulses thus propagate through the power drive coil 200 to the reader module pickup coil 160. Between the inhibit pulses, amplified oscillator energy provides power to charge the reader module battery 162. A receiver 176 on the reader module detects the signals from the tag and passes them on to the reader CPU 26. The unique time slots assigned to each hose allow multiple hoses to operate simultaneously without interfering with each other.

The operation of the present invention will now be described with reference to its application in a typical haulier fleet. Before leaving his depot, the driver is issued with a smart card which is programmed with information allowing him only to fill one or more selected vehicles with fuel. The smart card may also be programmed with other restrictions relating to specific petrol stations which may be used and the total amount of permitted fuel expenditure. The various restrictions on the card may be changed from one trip to the next, thereby allowing for highly flexible control of operations.

When the vehicle driver arrives at a filling station which has been suitably equipped, the driver inserts his smart card into the card reader 36 on the fuel pump 12. The computer 26 then verifies that the smart card is valid and may optionally prompt the driver for the odometer reading, which he may then enter via the keypad 30. The nozzle 16 is then inserted into the inlet pipe 66 of the fuel tank. The geometry of the antennae and the signal strength radiating from the antennae 102 and 120 are such that they will only pick up a response signal from the

identification tag 72 when the spout 104 is inserted completely into the fuel inlet pipe 66. The identification tag 72 comprises a small ferrite-cored coil connected to a printed circuit board which incorporates an integrated circuit. The transmitting antenna establishes an intermittent field of up to $10Vm^{-1}$ at 134.2 kHz, which charges the coil. As the field decays, the tag utilises its stored energy to transmit a 64 bit code at 134.2 kHz. The tag may be in the form of a 64 bit read only transponder such as the RI-TRP-RB2B-01 manufactured by Texas Instruments, Inc under the trade mark TIRIS®.

The return code from the identification tag 74 is fed back to the control computer 26 at the fuel pump via the coupling coil arrangement 112, the RF antenna multiplexer 46 and the RF reader module 28. The characteristic identification code from the identification tag is compared with the code stored on the smart card, which has already been entered into the control computer 26 via the card reader 36. If the two codes correspond, then the fuel pump will be activated, thereby allowing fuel to be transferred into the tank 68 as soon as the fuel handle 110 is depressed. Should the fuel nozzle 104 be removed at any time in order to fill another container illicitly, for instance, the fuel supply is immediately cut-off and the fuel pump concludes the transaction. Likewise, if an attempt is made to remove the smart card from the card reader 36, the pump similarly stops operation. When fuelling is complete, details as to the amount of fuel, the odometer reading, the pump location, the time and the date are written to the smart card. The smart card can now be used either as a direct or an indirect payment mechanism, depending on what prior arrangements have been made with financial institutions and fuel companies. When the driver returns to his

depot, all the details of his trip are immediately available to the fleet operator via the smart card. This allows the fleet operator to analyse and to monitor his fleet operations more closely.

It is becoming more commonplace for larger vehicles to be equipped with on-board computers. A smart card reader could thus be provided on the on-board computer to place vehicle information, such as odometer readings, directly on the smart card. The card could also be used as an interlock to prevent unauthorised vehicle drivers from operating the vehicle.

It must be emphasised that the apparatus of the invention is not confined to the monitoring of fuel, but may also be used to monitor the dispensing of any fluent materials.

CLAIMS

1.

An apparatus for monitoring the dispensing of a fluent material from a dispensing outlet to a receptacle inlet, the apparatus comprising sensing means for sensing when the dispensing outlet is in communication with receptacle inlet, and control means responsive to the sensing means and being arranged to enable the fluent material to be dispensed into the receptacle inlet only when the dispensing outlet is in communication therewith.

2.

An apparatus according to claim 1 in which the sensing means includes identification means arranged to generate an identification signal associated with the receptacle inlet, and receiving means associated with the dispensing outlet for receiving the identification signal.

3.

An apparatus according to claim 2 in which the identification means is arranged to transmit a first identification code identifying the receptacle in response to an activation signed from a transmitter associated with the dispensing outlet, and the control means includes entry means for entering a second code, and comparator means for comparing the first and second codes, the control means being arranged to enable fluid to be dispensed only in the event of the first identification code matching the second identification code.

4.

An apparatus according to either one of the preceding claims in which the identification means comprises an encoded tag and mounting means for mounting the tag adjacent the receptacle inlet.

5.

An apparatus according to claim 4 in which the mounting means include tag destruction means for rendering the tag inoperable on unauthorised removal of or tampering with the tag.

6.

An apparatus according to any one of claims 2 to 5 in which the receiving means comprises a transmitting and receiving antenna carried on the dispensing outlet, the antenna being arranged to receive the identification signal from the identification means only in the event of the dispensing outlet being in communication with the receptacle inlet.

7.

An apparatus according to claim 6 in which conductor means are provided for conducting the identification signal from the transmitter to the control means, the conductor means including an inductive coil arrangement provided on opposite sides of a rotary coupling.

8.

An apparatus according to any one of claims 4 to 6 in which the tag comprises a tuned sense coil, and a transmitter arranged to be modulated by the sense coil.

9.

An apparatus according to any one of claims 2 to 8 in which the dispensing outlet is movable between a stowage position on a fixture and a dispensing position, and remote powering means are provided on the fixture for remotely powering the receiving means.

10.

An apparatus according to claim 9 in which the remote powering means is arranged, via the control means, to inhibit the operation of the receiver means when the dispensing outlet is in the stowage position.

11.

An apparatus according to either one of the preceding claims which includes synchronisation means arranged to assign characteristic time slots to a plurality of receiving means for allowing the plurality of receiving means to operate simultaneously.

12.

An apparatus according to claim 3 in which the second code is stored on a memory device, such as a magnetic or a smart card, and the entry means comprises a keyboard, a magnetic card reader or a smart card reader.

13.

An apparatus according to claim 12 in which additional restrictive data is stored on the memory device, such as a maximum quota of fluent material, and a list of permitted dispensing outlets, with the control means being operable to prevent the dispensing of fluent material in response to receipt of the restrictive data.

14.

An apparatus according to claim 13 in which the control means are arranged to write data back onto the memory device, the date including at least one of the following, namely the amount of fluent material dispensed in respect of a particular transaction, the cost of such material, the time and date, the identity of the dispensing outlet, and an odometer reading.

15.

An apparatus according to claim 6 in which the antenna is arranged to transmit the identification signal to the control means.

16.

An apparatus according to any one of the preceding claims in which the fluent material is fuel, the dispensing outlet is a fuel nozzle and the receptacle inlet is a fuel tank inlet.

17.

A method of monitoring the dispensing of a fluent material from a dispensing outlet to a receptacle inlet, comprising the steps of:

a) sensing when the dispensing outlet is in communication with the receptacle inlet;

b) allowing fluent material to be dispensed when the dispensing outlet is in communication with the receptacle inlet, and

c) barring the dispensing of fluent material when the dispensing outlet is moved out of communication with the receptacle inlet.

18.

A method according to claim 14 which includes the steps of transmitting a first identification code associated with the receptacle inlet to a control station, entering a second identification code at the control station, comparing the first and the second identification codes and enabling the dispensing of fluent material only in the event of the first and second identification codes matching and the dispensing outlet being in communication with the receptacle inlet.

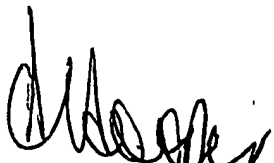
19.

An apparatus for monitoring the dispensing of a fluent material substantially as herein described and illustrated.

20.

A method of monitoring the dispensing of a fluent material substantially as herein described and illustrated.

DATED THIS 17TH DAY OF JUNE 1994



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APPLICANT'S PATENT ATTORNEYS

ADVANCED TRANSPORTATION INFORMATION SYSTEMS (PTY) LIMITED
COMPLETE SPECIFICATION

4 SHEETS
SHEET 1

FIG 1

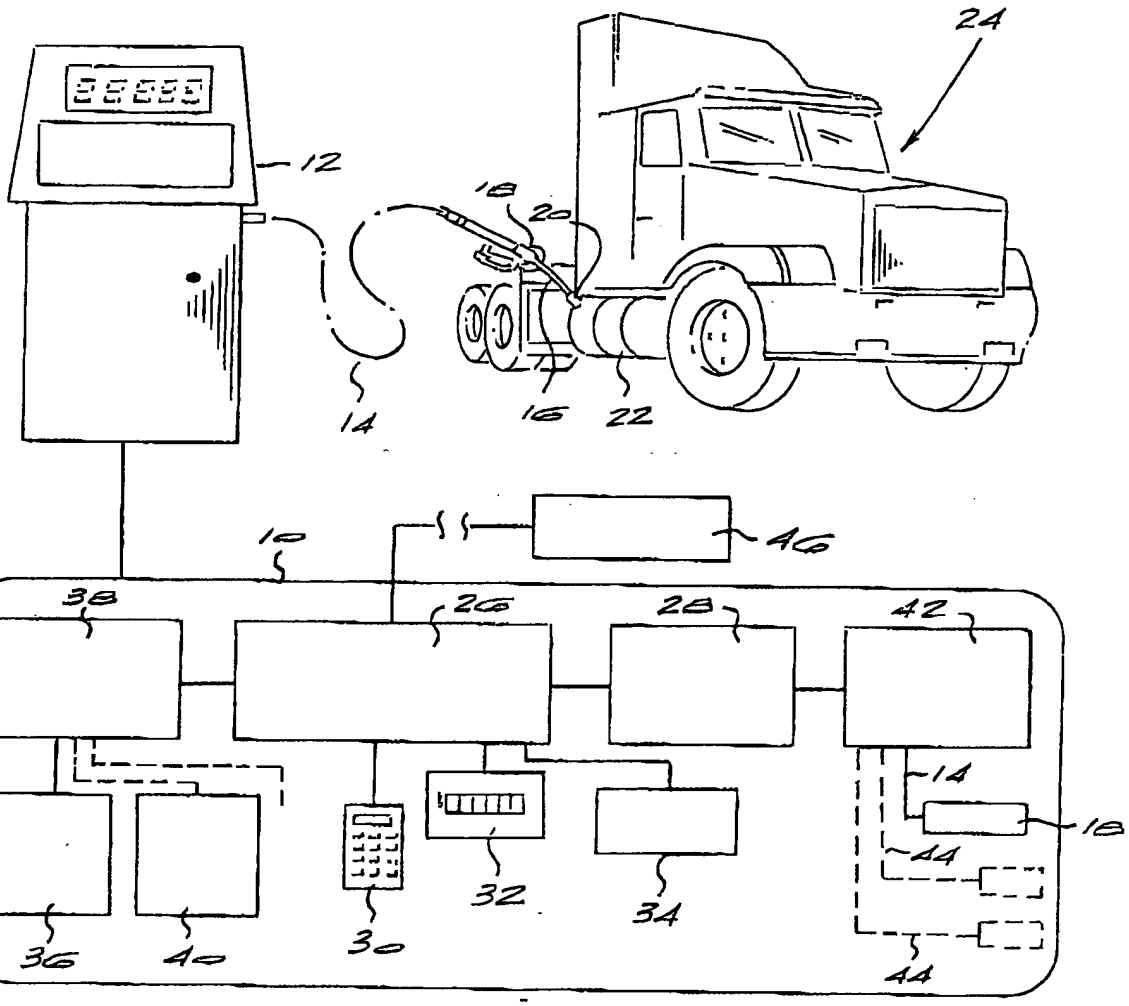


FIG 2A

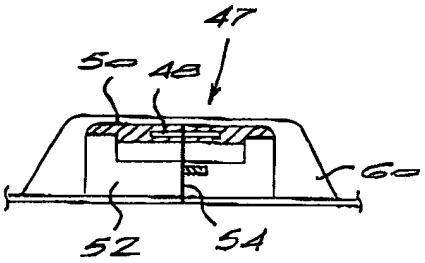


FIG 2B

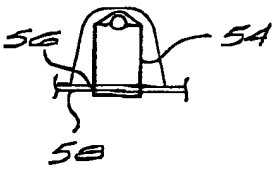


FIG 3

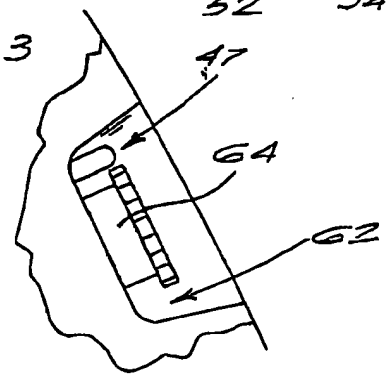
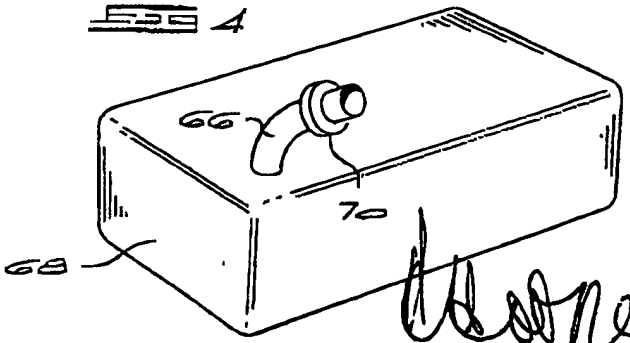


FIG 4



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ADVANCED TRANSPORTATION INFORMATION SYSTEMS (PTY) LIMITED

COMPLETE SPECIFICATION

4 SHEETS
SHEET 2

FIG 5A

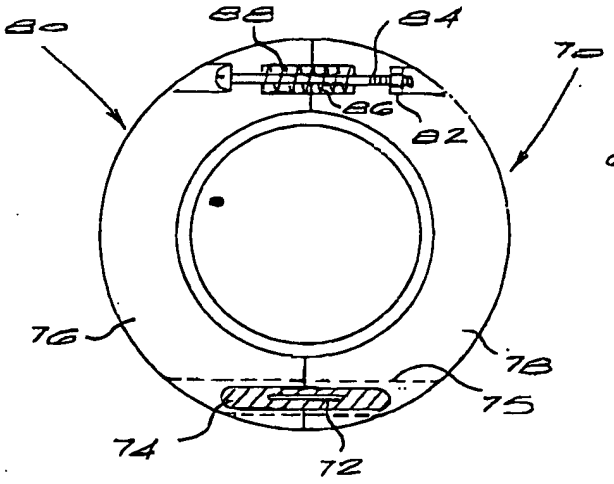


FIG 5B

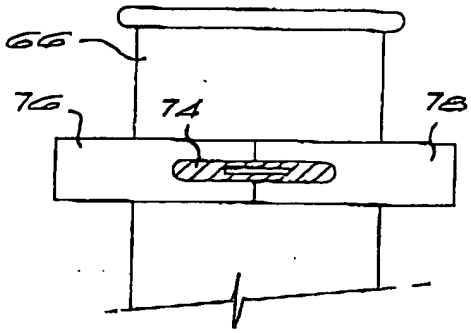


FIG 6

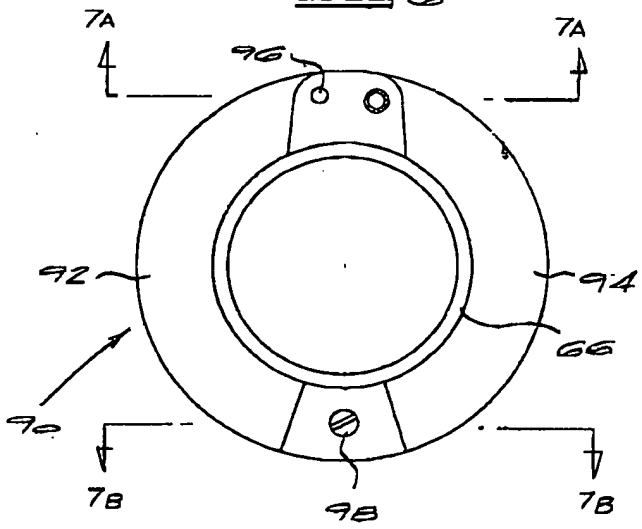


FIG 7A

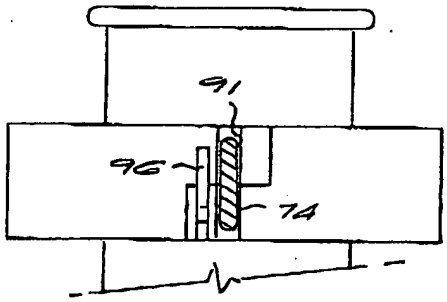


FIG 7B

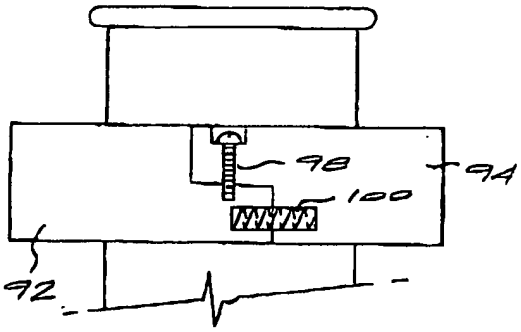


FIG 8

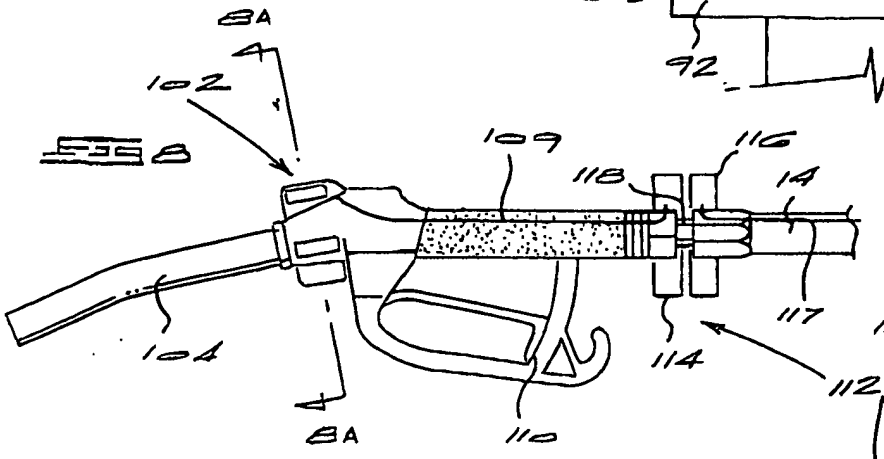
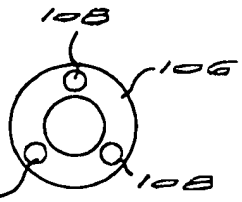


FIG 8A



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ADVANCED TRANSPORTATION INFORMATION SYSTEMS (PTY) LIMITED
COMPLETE SPECIFICATION

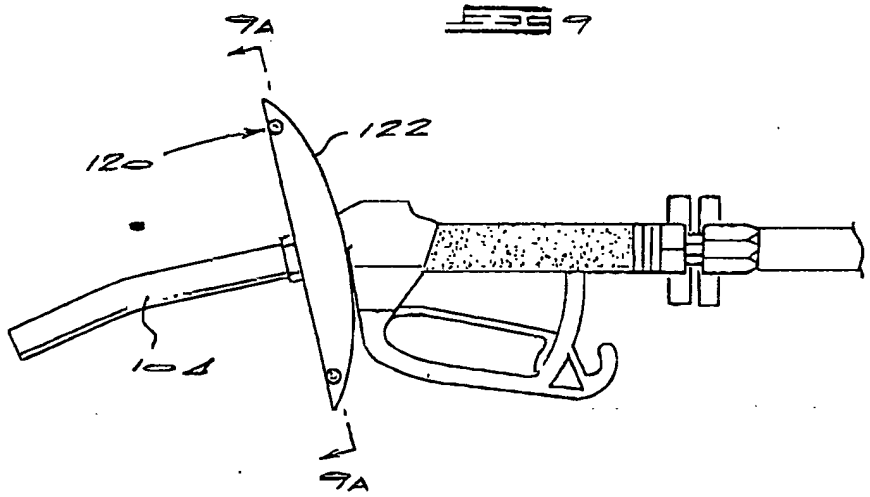

FIG 9

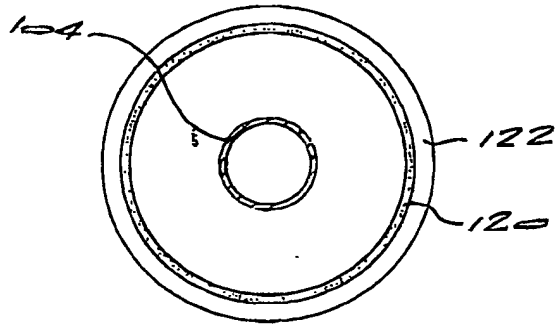

FIG 9A

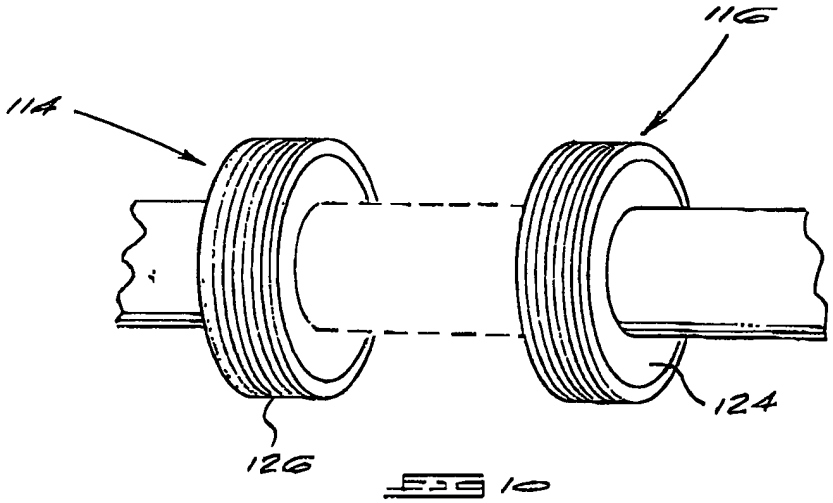

FIG 10

SPOOR and FISHER
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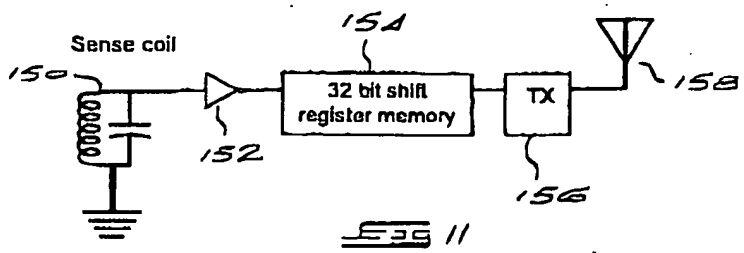

FIG 11

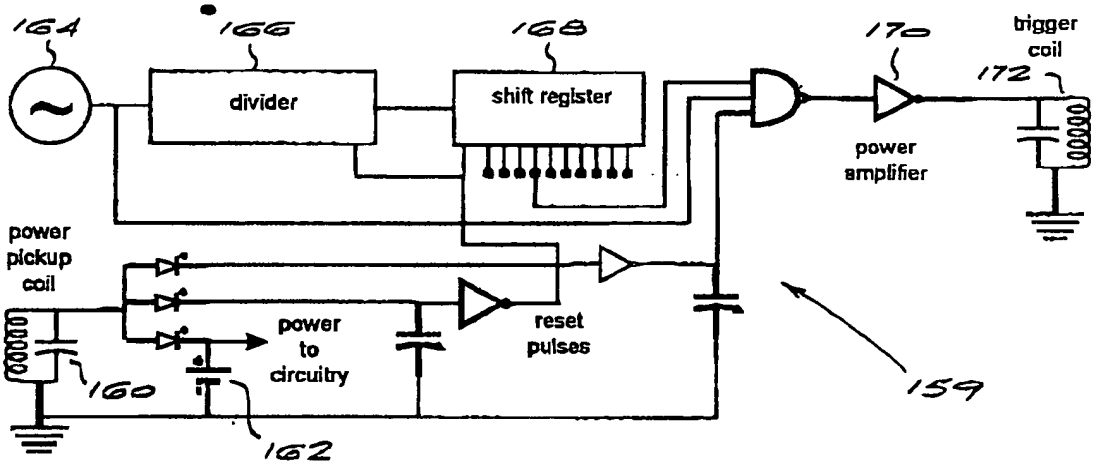

FIG 12

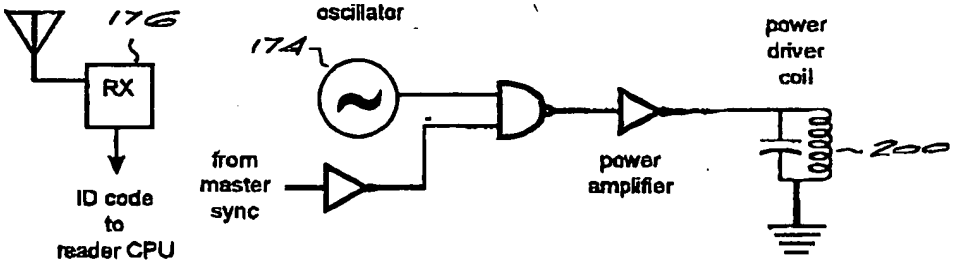

FIG 13

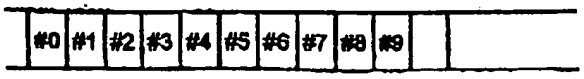

FIG 14

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APPLICANTS PATENT ATTORNEYS